

Rehabilitation of Pipeline Systems using Trenchless Technologies

Primus Line Company Introduction

- Part of the *Werner Rädlinger Group*
 - RW Energy
 - Maschinen- und Stahlbau
 - Primus Line
 - BBZ Schwandorf
 - Founded in 2001
 - Worldwide offices
 - Primus Line Inc.
 - Primus Line CA Inc.
 - Primus Line Pty Ltd.
 - Primus Line (China) Ltd.
- Installation partners in more than 50 countries





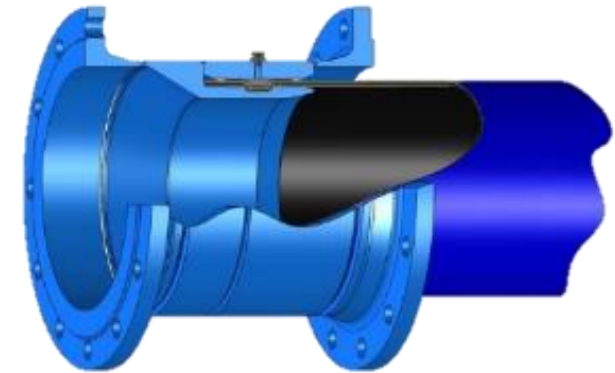
The Primus Line[®] system

Components

Components of the Primus Line System



Flexible High-Pressure Liner



Patented End Fittings

Composition of the Primus Liner

External layer

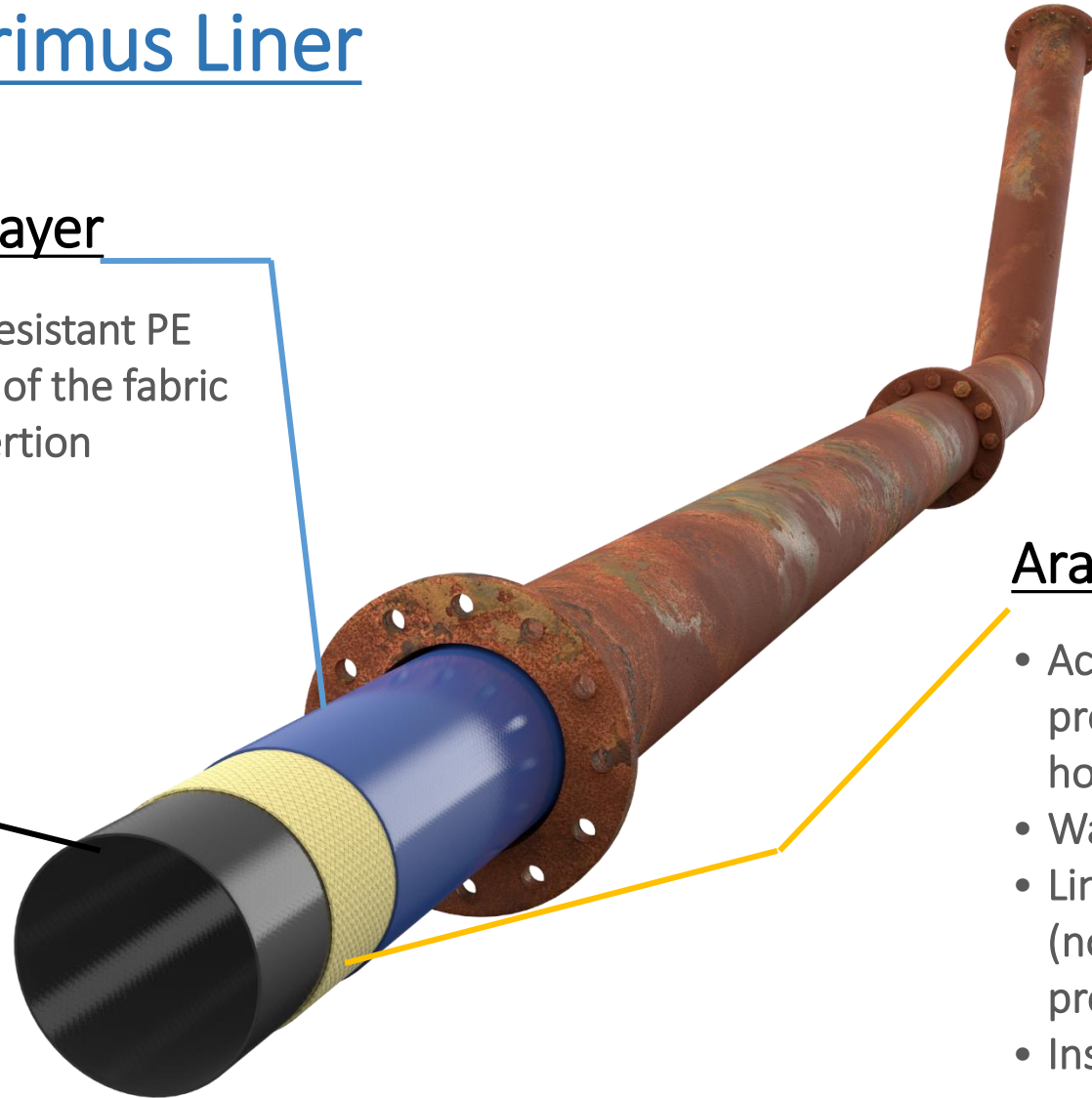
- Abrasion-resistant PE
- Protection of the fabric during insertion

Internal layer

- Based on PE
- NSF/ANSI 61, KTW W 270, AS/NZS 4020:2005

Aramid fabric

- Accommodates the operating pressure independently from host pipe
- Wall thickness of 6 mm
- Liner is not glued to host pipe (no steaming or curing processes)
- Installed with annulus space



Product Portfolio

	Primus Line® low pressure						Primus Line® medium pressure						Primus Line® high pressure										
	single-layer hybrid design						single-layer Kevlar® design						double-layer Kevlar® design										
	OD	t	ID	burst	MOP water	weight water	OD	t	ID	burst	MOP water	weight water	MOP oil/gas	weight oil/gas	OD	t	ID	burst	MOP water	weight water	MOP oil/gas	weight oil/gas	
	mm	mm	mm	bar	bar	kg/m	mm	mm	mm	bar	bar	kg/m	bar	kg/m	mm	mm	mm	bar	bar	g/m	bar	kg/m	
Primus Line® DN 150	134	6.0	122	63	25	2.1	134	6.0	122	140	56	2.2	35	2.4	-	-	-	-	-	-	-	-	-
Primus Line® SD 150	150	6.0	138	54	20	2.4	150	6.0	138	120	48	2.4	30	2.7	160	8.0	144	206	82	3.3	51	3.6	
Primus Line® DN 200	182	6.0	170	47	18	2.9	182	6.0	170	100	40	3.0	25	3.3	192	8.0	176	173	69	4.0	43	4.4	
Primus Line® SD 203	203	6.0	191	42	16	3.3	203	6.0	191	84	33	3.4	21	3.8	-	-	-	-	-	-	-	-	-
Primus Line® DN 250	237	6.0	225	38	15	3.8	237	6.0	225	75	30	4.0	18	4.4	250	8.0	234	128	51	5.3	32	5.8	
Primus Line® SD 261	261	6.0	249	30	12	4.2	261	6.0	249	64	25	4.4	16	4.9	-	-	-	-	-	-	-	-	-
Primus Line® DN 300	284	6.0	272	30	12	4.6	284	6.0	272	64	25	4.8	16	5.3	294	8.0	278	110	44	6.4	27	6.9	
Primus Line® DN 350	-	-	-	-	-	-	314	6.0	302	50	20	5.2	12	5.9	-	-	-	-	-	-	-	-	-
Primus Line® DN 400	-	-	-	-	-	-	354	6.0	342	46	18	6.0	11	6.7	364	8.0	348	82	32	8.1	20	8.8	
Primus Line® DN 450	-	-	-	-	-	-	408	6.0	396	40	16	7.0	10	7.8	-	-	-	-	-	-	-	-	-
Primus Line® DN 500	-	-	-	-	-	-	454	6.0	442	40	16	7.7	10	8.6	-	-	-	-	-	-	-	-	-

Performance & Testing

- Testing basis VP 643, June 2004 – Flexible, fabric-reinforced plastic liners and corresponding connectors
- Verification of long-term strength according to DIN 16887 and DIN EN ISO 9080 in a series of up to 10,000 hour tests extrapolated to 50 years derived a fabric factor of 2.0
- An additional safety factor of 1.25 is included

Example DN 200-MD*

- | | |
|-----------------------|---------|
| ■ Burst pressure | 100 bar |
| | ↓ /2 |
| ■ Lifetime factor | 50 bar |
| | ↓ /1.25 |
| ■ Safety factor water | 40 bar |



*Straight pipe sections, without bends



The Primus Line[®] System

Installation Process

Installation agenda

1. Site preparation

Take pipeline out of service

Create access pits



2. Pipe cleaning & CCTV

Pipe inspection with CCTV

Remove incrustations / protruding welds

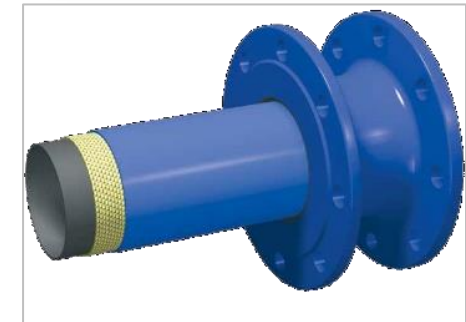
Create free inner diameter



3. Installation of the system

Insertion and inflation of the liner

Installation of connectors



1. Site Preparation

Start-pit



Pipe diameter	Working space
DN 150 – DN 200	min. 1.25 m
DN 250 – DN 500	min. 1.75 m

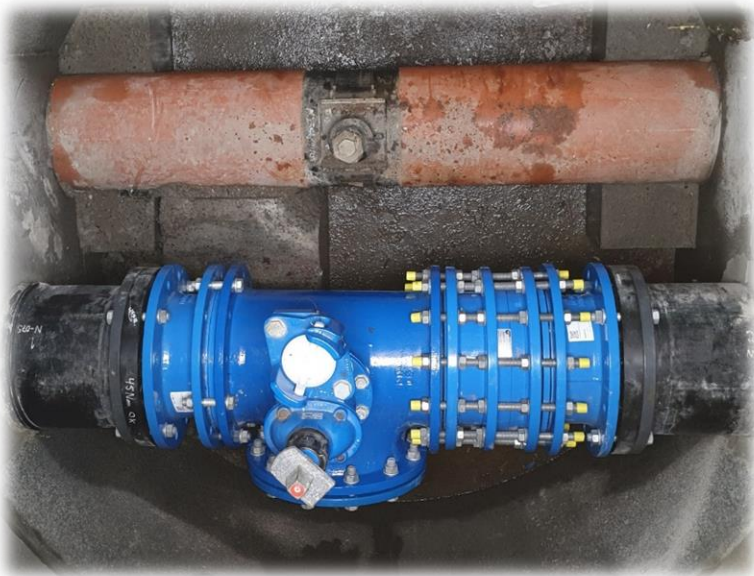
- Pipe cut in a 90 degree angle to pipe axis
- Pipe ID to be deburred and chambered
- Use of insertion roll to protect liner

➤ Man-hole

➤ Excavation pit

1. Site Preparation

Intra-pit



➤ Man-hole



➤ Excavation pit

Pipe diameter	Working space
DN 150 – DN 200	min. 1.50 m
DN 250 – DN 500	min. 2.00 m

- Pipe cut in a 90 degree angle to pipe axis
- Pipe ID to be deburred and chambered

1. Site Preparation

Destination pit



Pipe diameter	Working space	Pulling force	Exit angle
DN 150 – DN 200	min. 1.25 m	< 3 tons	max. 30 degree
DN 250 – DN 500	min. 1.75 m	> 3 tons	max. 10 degree

2. Pipe Cleaning & CCTV

CCTV inspection goal:

→ Determine cleaning needs



- Focus on reductions in cross-section caused by protruding obstacles (weld seams, fittings, pins)
 - Bends
 - Steps
 - 360 degree inspection of pipe joints
- CCTV used as a means to create the initial rope connection between pits

2. Pipe Cleaning & CCTV

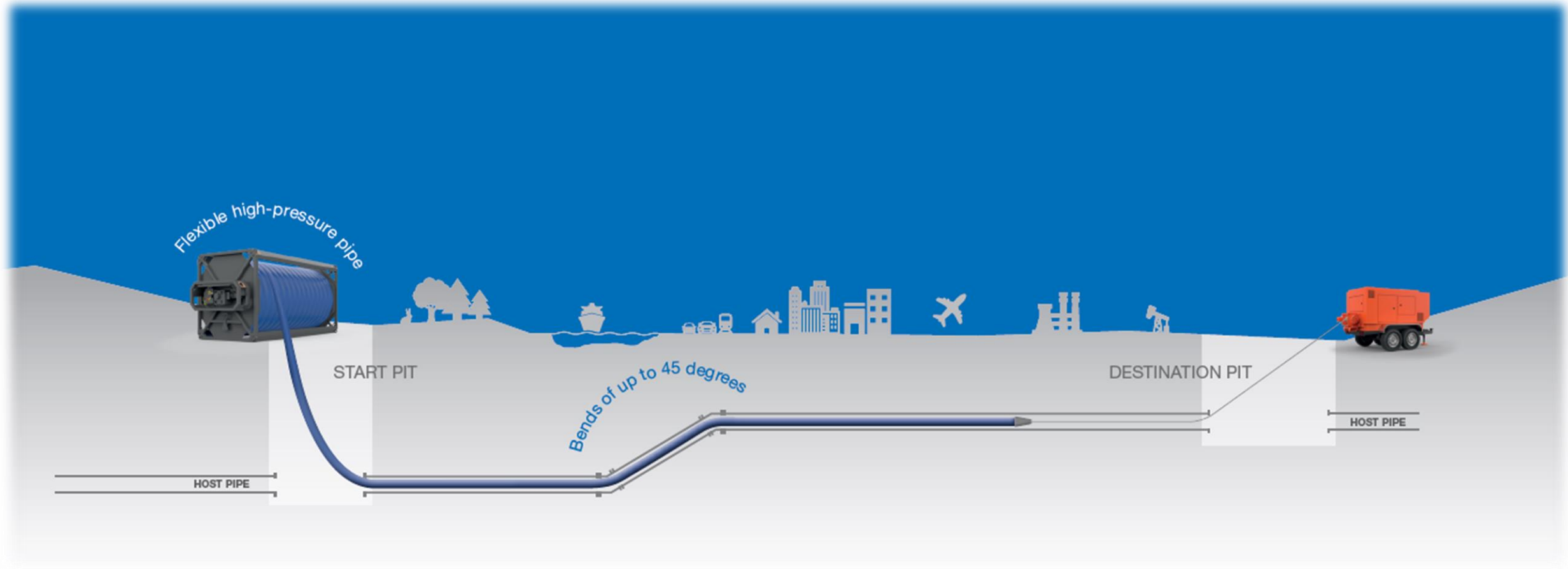
Goal: Create a free inside diameter

- Cleaning requirements dependent on host pipe material
- Subsequent CCTV inspection to verify free inside diameter



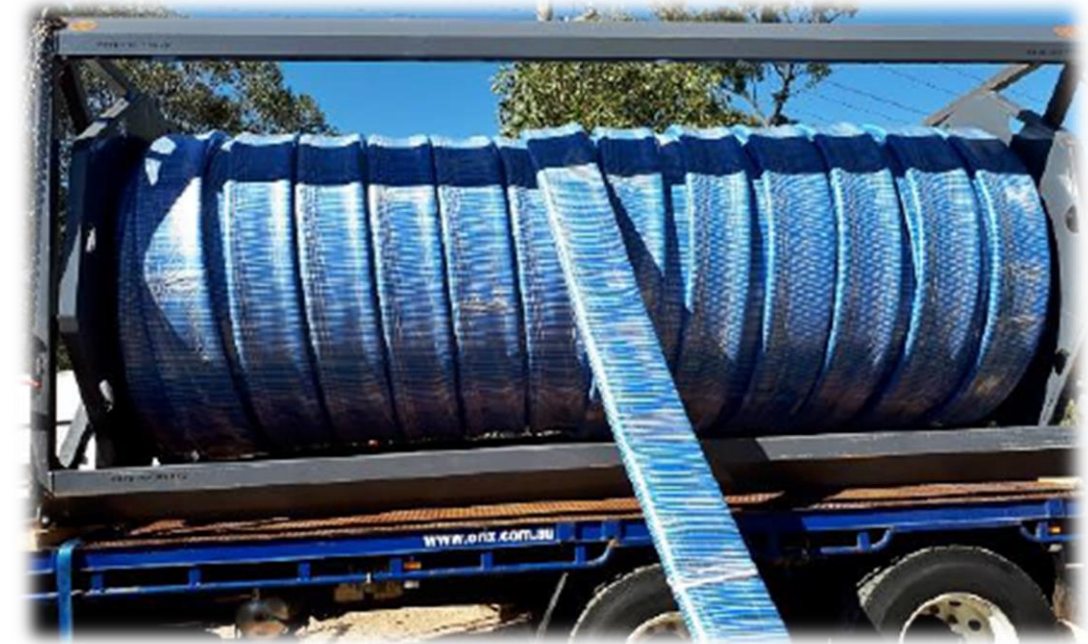
3. Installation of the System

Liner insertion



3. Installation of the System

Drum capacities

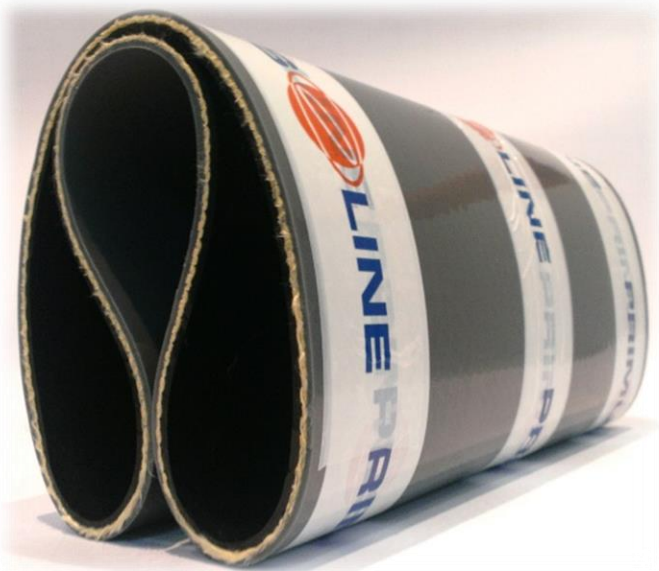


Diameter	Reel capacity
DN 150	up to 5,700 m
DN 500	up to 1,675 m

- Width: 1.40 m – 11.00 m
- Suitable for 20ft. and 40ft. Containers
- Smaller reels via airfreight possible

3. Installation of the System

Liner pre-folded in U-shape at factory



Reduce pulling forces to achieve long insertion lengths

Liner insertion



Pulling forces up to 5 tons depending on reinforcement layer



Pulling forces up to 10 tons depending on reinforcement layer

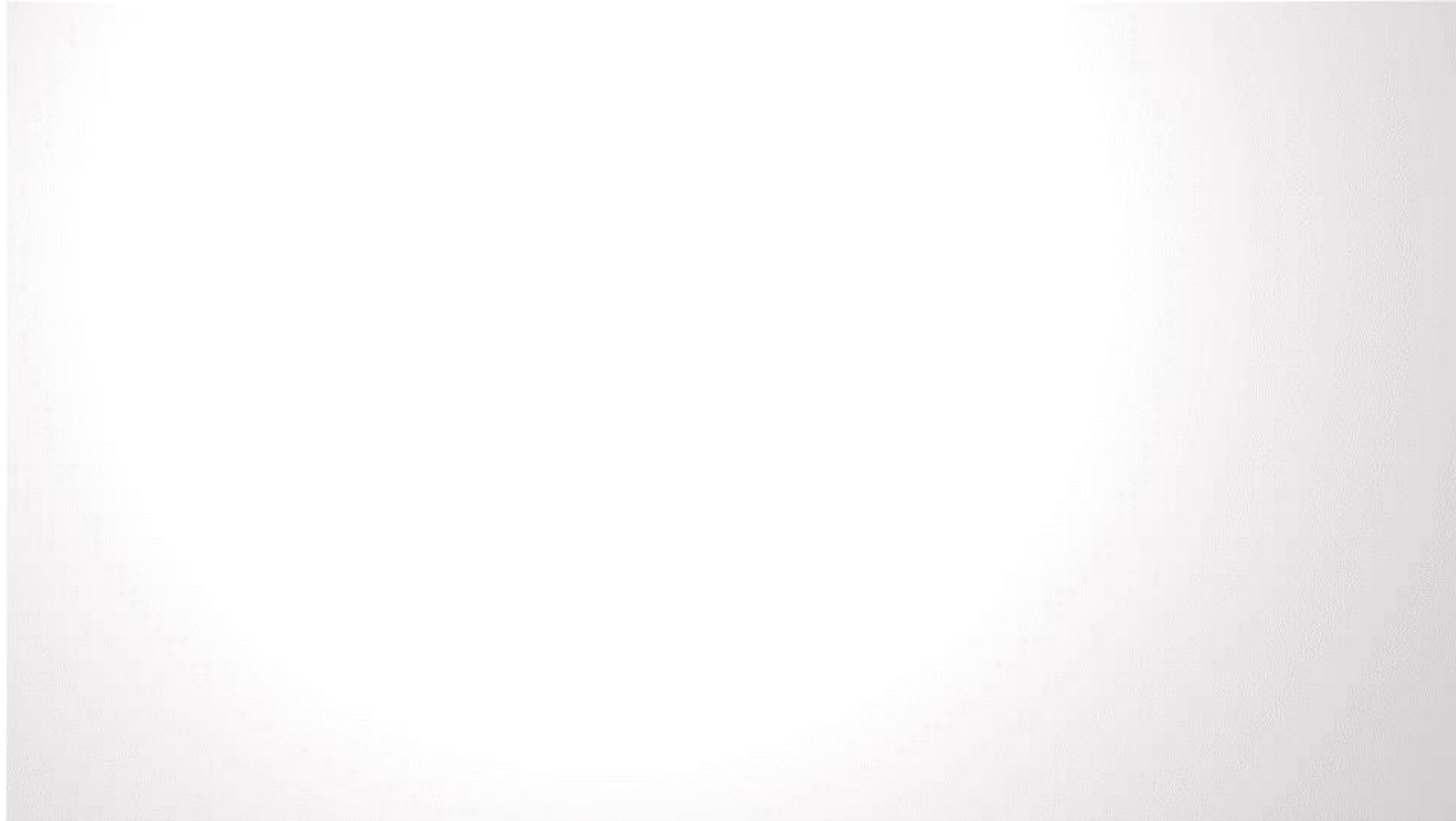
3. Installation of the System

U-shaped configuration during insertion



3. Installation of the System

Ability to handle bends



3. Installation of the System

Inflation process with compressed air

- Oil-free air for potable water
- Pipe stopper to close liner
- Pipe stopper with by-pass to inflate
- No heating, steaming, curing processes

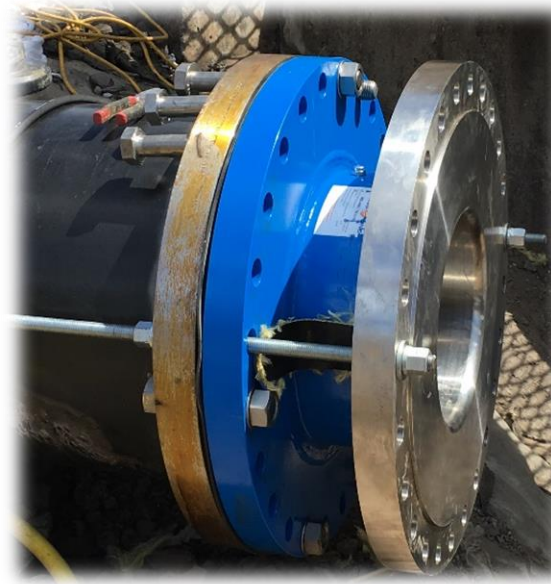


3. Installation of the System

Connector DN 500 with flange DN 600



Different flange standards



- Pressure testing based on pressure loss method as described in DIN EN 805
- Disinfection according to the acknowledged rules of technology for disinfecting pipes made from PE

Primus Line Benefits in a Nutshell

- Long installation lengths with 1,000 m and more
- Ability to traverse around bends of up to 45 degree
- Fast installation with up to 600 m/h
- Small footprint and minimum equipment requirements on-site
- Fully factory produced product with no curing, steaming or adhesion processes on site



Case studies

Case Study: Reocín, Spain

Job Report



Rehabilitation of an asbestos cement trunk water main with a length of 10 kilometres

Client:
Municipality of Reocín, Spain

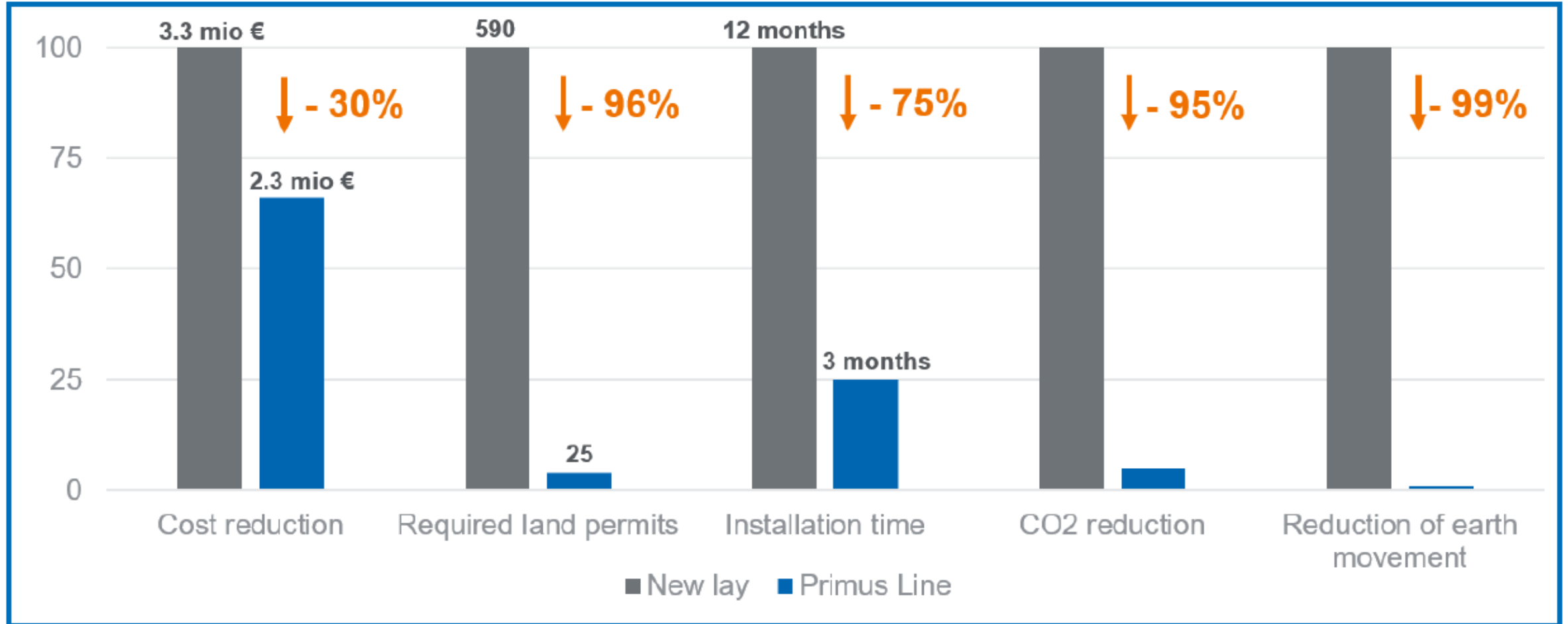
Year of construction:
December 2016 – April 2017

Type of construction measure:
Rehabilitation of an asbestos cement trunk water main

Technical Details:

Material of host pipe	Asbestos cement
Transported fluid	Drinking water
Diameter of Host Pipe	DN 250
Operating Pressure	7 bar
Primus Line System	DN 250 PN15; DN 200 PN 18
Total Length	10.345 m
Number of sections	20
Installation Time	4 months

Case Study: Reocín, Spain

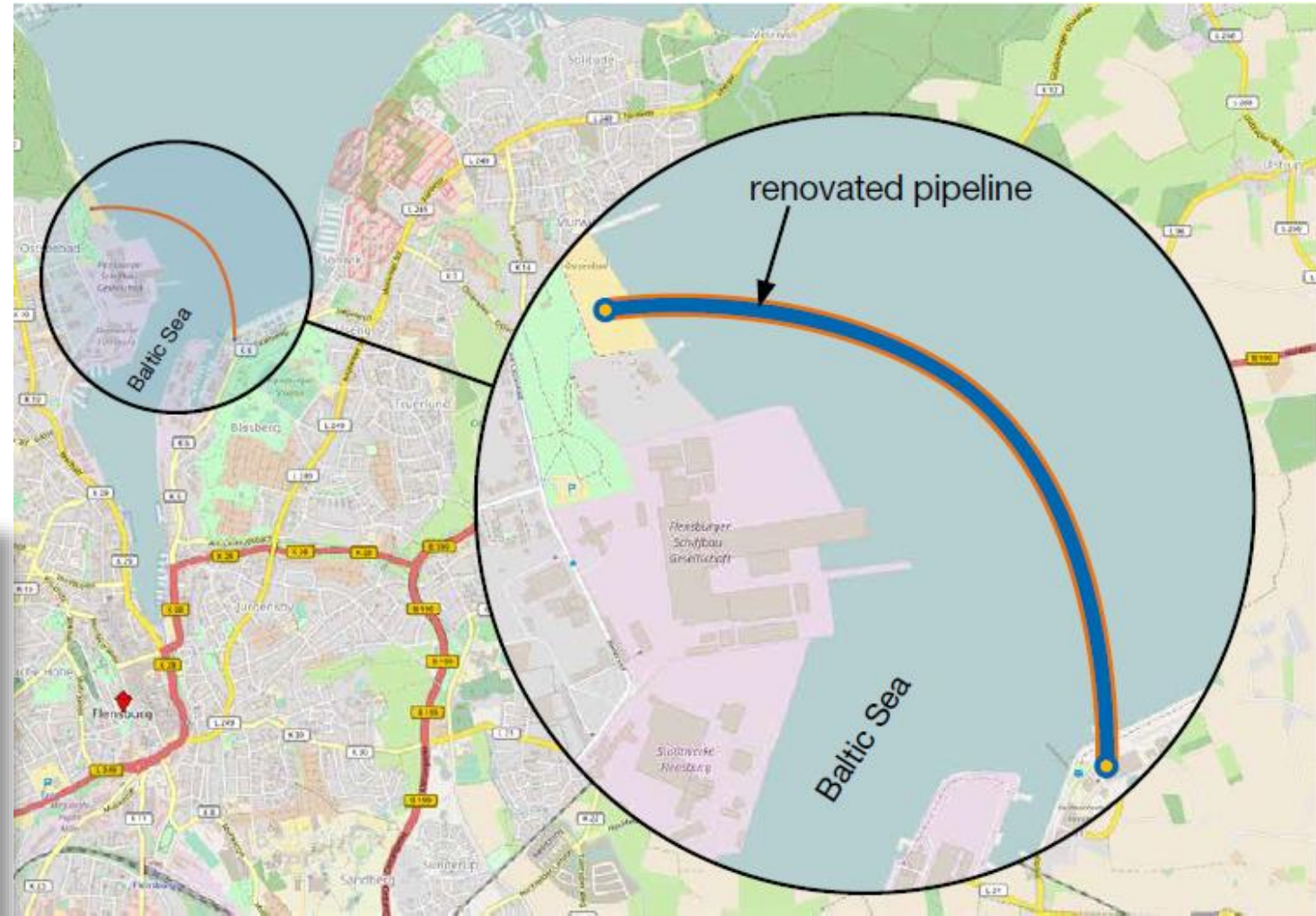


Case Study: Flensburg, Germany

Technical Details:

Material of host pipe
Transported fluid
Diameter of Host Pipe
Operating Pressure
Primus Line System

PE 80 from 1970
Potable water
DN 250
10 bar
DN 250 single-layer
1240 m
8 working days



with appropriate permission.

Case Study: Van Donh Island, Vietnam

★ Job Report



Technical Details:

Material of host pipe	Steel, unlined
Transported fluid	Potable water
Diameter of Host Pipe	DN 300
Operating Pressure	6 bar
Primus Line System	DN 300 PN 12
Total Length	840 m
Sections	410 m, 170 m, 270 m
Installation Time	3 Weeks

Rehabilitation of DN 300 water pipes at Van Don bridge

Client:

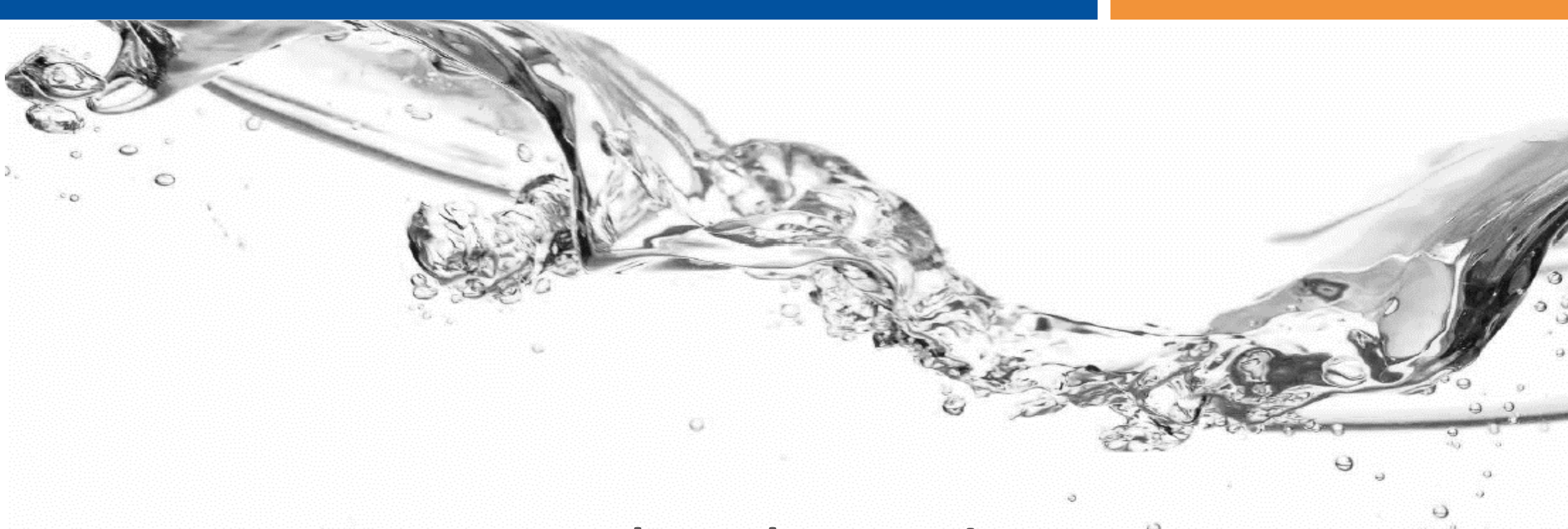
Quang Ninh Water Company (QUAWACO)

Year of construction:

September 2019

Type of construction measure:

Rehabilitation of a DN 300 steel water main located at Van Don Island, Vietnam



Thank you!